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ABSTRACT

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Interlanguage Phonology: The Perceptual Development of Durational Contrasts by English-Speaking Learners of Japanese.

Kayoko Enomoto (DAL)

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INTERLANGUAGE PHONOLOGY: THE PERCEPTUAL DEVELOPMENT OF DURATIONAL CONTRASTS BY ENGLISH-SPEAKING LEARNERS OF JAPANESE

Kayoko Enomoto (DAL)

Abstract

This paper reports upon a small-scale pilot study for further investigation into the perceptual development in the acquisition of durational contrasts by different levels of adult English-speakers of Japanese. Four kinds of naturally spoken word-tokens were edited by a synthesizer to generate word-stimuli varying the duration of a certain consonant/vowel (originally contained in each word-token) along a durational continuum. These synthetic word-stimuli were randomised and presented to both native speakers and English- speaking learners of Japanese, in four forced-choice word identification tasks. The overall identification data in all tasks, indicated that the L2 learners' levels of language experience/proficiency correlated positively with the closeness of their perceptual categories of the durational continua, to the perceptual categorisation of the native speaker group. This seems to imply that the L2 learners' initial perceptual categories or perceptual targets, may be possibly modified/developed towards the 'categorical perception' model shown by the native speakers in the course of adult L2 acquisition.

1. A brief review of studies of interlanguage phonology

In the history of SLA research, a great deal of attention has been paid to grammatical domains of language acquisition (morphology/syntax), yet until the last decade, the acquisition of L2 phonology remained relatively neglected. In the comparatively short time span of study in this area, much research on IL phonology has been conducted, seemingly taking two major theoretical approaches to IL phonology: one perspective emphasises the pervasiveness of (L1) phonological transfer and the other (in one way or another) takes the influence of phonological universals and markedness hierarchy into account in developing an IL phonological theory/model.

With regard to the former perspective, the contrastive analysis hypothesis (cf. Lado 1957) seems to represent the most accessible theory to many language teachers, providing them with relatively accessible and straightforward principles for both predicting and explaining learning problems in the classroom. In the domain of phonology, contrastive phonology is conducted, based on comparison of the sound systems of two languages, i.e. by establishing measures of structural divergence/convergence between specific aspects of the two sound systems. Such measures serve to determine which features of the L1 are to be transferred to the L2, by taking a directional approach from one to the other. In this view, the learner's phonological errors are attributed to the negative transfer of the L1 phonological features to the L2.

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It has to be stressed that there seems to be more support for the view that L1 experience does (in some way) affect L2 acquisition (i.e. the transfer position) in the area of phonology than in the other domains of acquisition. Thus, in many studies of IL phonology, there is considerable, but not total, support for specific predictions, such as from contrastive phonology, despite deep theoretical and methodological problems.

Likewise, apparently supporting the view that L1 linguistic experience affects L2 phonological acquisition, Flege (1980, 1981, 1987) hypothesised a cognitive mechanism, 'equivalence classification', as a major cause of difficulties in acquiring L2 sounds. The equivalence classification hypothesis proposes that the L2 learner, having established his L1 phonological system, fails to develop separate 'perceptual targets' for the L2 sounds with phonetically 'similar' counterparts in the L1. As a result of this, the learner develops an inaccurate perceptual target, which is a 'merged system' of the L1 and L2 phonetic properties.

On the other hand, with regard to the latter perspective, Major (1987) proposes the ontogeny model, focussing on the 'interaction' between interference (i.e. L1 negative transfer) and developmental processes/factors (i.e. common phenomena between L1 and L2 acquisition), although the distinction between the two (factors) remains undetermined in some cases. Eckman (1977), considering the influence of the markedness hierarchy, proposed the markedness differential hypothesis (MDH) by incorporating the definition of typological markedness concept into the contrastive analysis hypothesis, in order to predict the degree and directionality of difficulty in L2 acquisition. However, Fellbaum (1986) further proposed a revised version of the MDH, by incorporating into the MDH the markedness not only of phonemes but also of allophones, because the original MDH prediction was limited to the acquisition of phonemes, (as is contrastive phonological analysis).

With these two major theoretical perspectives influencing the formation of IL phonological models/theories, studies of IL phonology have investigated to what extent phonological transfer and phonological universals operate upon the formation of an IL phonology. However, as such studies as a whole have produced neither a sequential nor an interrelated set of theoretical and empirical outcomes, the research in this area, seems as yet to be in its infancy in both theoretical and empirical terms.

The results presented and the line of reasoning followed in this paper may seem to be aligned more closely with the L1 transfer position, using certain facts/properties in the L1 phonological system to account for the IL phonology. However, it is not my intention to address the question of whether or not these two (seemingly opposed) theoretical polarities (i.e. transfer vs. phonological universals) are empirically plausible, although there has been considerable debate about this, particularly in other domains of acquisition (e.g. Dulay, Burt and Krashen 1982).

2. Phonetic background for the acquisition of durational contrasts

In certain languages, segmental duration serves as the primary cue for the distinction between certain classes of phonemes. For example, long vowels contrast with short ones in Danish, Arabic and Korean, and long consonants contrast with short ones in Italian (Ladefoged 1982). Likewise, in Japanese all the vowels and some consonants can be discriminated from their geminate/long counterparts, primarily by their durational

differences, and Japanese is a language which utilises duration to distinguish meanings, i.e. short-long variations in length are used phonemically to distinguish meanings. In the distinctive feature theoretical framework (Chomsky and Halle 1968), the duration of such sounds can be regarded as one of the distinctive features, which can be opposed to all the other features.

By contrast, in English, it is said that the vowel before the voiced consonant /d/ is longer than the same vowel before the voiceless consonant /t/ with other properties being equal, an example of this being "bad"-"bat". Ladefoged (1982) states that, in most varieties of English, vowel lengths are allophonic. With regard to consonant length in English, long consonants exist only across word-boundary or morpheme-boundary as in "white tie" and "unknown" respectively, whereas in Japanese, they occur within a morpheme boundary, as in Italian.

In sum, the phonetic background for the acquisition of Japanese durational contrasts is that, whilst in English duration is not distinctive nor phonemic, it is in Japanese. This presents examples of particular research interest to L2 phonological acquisition research. In fact, in the literature on the acquisition of the Japanese phonological system, it is commonly stated that both perceiving and producing durational contrasts presents great difficulties to L2 learners of Japanese. My informal classroom observation also suggests that this is the case for English-speaking learners of Japanese. The following are the examples of such durationally-contrasted pairs of words in Japanese, to be investigated in the present study:

[iken] vs. [ikken]	'opinion'	vs.	'one house'
[niši] vs. [nišši]	'west'	vs.	'journal'
[sama] vs. [samma]	'Mr/Ms'	vs.	'mackerel/pike-like fish'
[kado] vs. [kaado]	'corner'	vs.	'card'

3. Perception vs. production of L2 sounds

By those adopting the transfer position outlined earlier, it has been proposed that the phonetic ability of L2 learners may be affected by their own L1s. More specifically, L2 learners have difficulty in both perceiving and producing sounds, (1) which do not exist in their L1s, or (2) between which distinction does not exist in their L1s. As the latter case applies to the acquisitional context in the present study, it can be proposed that both perceiving and producing durational contrasts is difficult for English-speakers, given that durational distinction does not exist in English.

In relation to the perception and production of L2 sounds, a theoretical proposition which provides an important research insight into the present study is the equivalence classification hypothesis (Flege 1980, 1981, 1987). This hypothesis is innovative in the sense that it sheds light on the role of perception, by identifying and differentiating two dimensions in the acquisition of L2 sounds, i.e. perception and production, rather than relating production solely to the acquisition of L2 sounds.

The hypothesis proposes that establishing inaccurate 'perceptual targets' or 'mental representation' affects the learner's production ability, which may result in his foreign accent (Flege and Hillenbrand 1984). Thus, this theoretical proposition seems to be based upon the assumption that perceptual ability precedes production ability. On this point, however, previous studies (both in the fields of L2 phonology and

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phonetics/phonology) do not directly address the directionality of the cause and effect relationship between perception and production, nor do they provide empirical evidence for (whatever kind of) alignment between perception and production.

The results from a number of studies (Flege 1984, 1987; Flege and Eefting 1986; Flege and Hillenbrand 1984) support the above hypothesis, indicating that, as a result of the operation of equivalence classification in perception, L2 learners approximate the sounds that are acoustically/phonetically 'similar' (e.g. differences in VOT values)[1] in the L1 and L2, and often produce somewhat intermediate sounds that are found neither in L1 nor in L2. On the other hand, it has also been shown that L2 learners may succeed in establishing totally accurate perceptual targets for the 'new' L2 sounds that have no direct L1 counterparts.

For instance, by investigating the production data of American English speaking learners of French, Flege and Hillenbrand (1984) present empirical evidence that English-speakers produce French /t/ with longer English-like VOT values, i.e. (somewhat) intermediate values of two segmental phonetic features in the L1 and L2, because there is a merged system of the VOT properties of the French /t/ (with its short-lag VOT values) and the English /t/ (with its long-lag VOT values). Similarly, the study by Flege (1987) also shows that English-speakers of French approximated the vowel formant values[2] of the French /y/, much more closely to those obtained from French monolingual speakers, than the formant values of the French /u/; the French /y/ is a 'new' phone with no direct counterpart in English, whilst the French /u/ is a 'similar' one which is produced with (substantially) higher F2 values (the frequency of the second formant) than its English counterpart.

Thus, the above studies largely support the proposition that observed approximation in production of 'similar' L2 sounds, results from the establishment of inaccurate perceptual targets. However, as regards the perception data to empirically verify such an establishment of inaccurate perceptual targets, there have been a very small number of studies which have rigorously investigated L2 perceptual data in the study of L2 phonology. Likewise, in the area of phonetics/phonology, it seems also characteristic that, whilst a huge literature on production data exists, there has been considerably less research attention given to perceptual experiments.

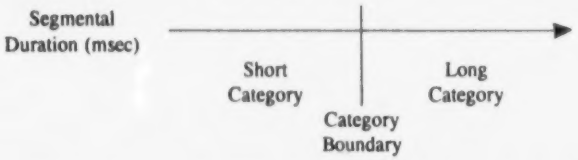
The present study, by collecting the perception data, is designed to investigate the relationship of the L1 linguistic, i.e. perceptual, experience as well as the relationship of different levels of L2 proficiency/language experience to the perception of durationally-contrasted L2 sounds. The goal of the research is to investigate the nature of 'perceptual targets' for durational contrasts, which the L2 learners (it is hypothesised) establish, possess and may possibly develop, at the different levels of proficiency/language experience in the L2. In the present study, such 'perceptual targets' were specifically referred to as 'perceptual categories' of durational contrasts. Thus, this study adopted the methodology of 'categorical perception' research, which enables us to quantify different perceptual categories by using the measures of perceptual discrimination tests, and to examine how categorical such perceptual category-assignments are, at different levels of language experience/proficiency.

4. Categorical perception

Categorical perception (CP) refers to the experience of discontinuity as a series of stimuli from a physical continuum cross a category boundary, together with the perceptual absence of (clear) changes within a category. A good example of this is our perception of colours (Harnad 1987): we only perceive qualitative changes, e.g. from red-orange-yellow-green, etc., although there are gradual quantitative changes in their wavelengths across the spectrum of visible colours.

> Categorical perception is said to occur if the subject cannot discriminate speech sounds any better than she can identify them within different phonological categories. Under these conditions, equal increments along a phonetically relevant articulatory continuum (with acoustic consequences) are not discriminated unless the increment crosses the boundary between phonetic categories.
>
> (MacKain et al.:1981:371)

Since the 1960's, CP research has been largely developed in the speech domain, with most research concerned with the role of phonetic categories, i.e. the phonetic segments/phonemes, in a native-speaker perceiver's perceptual processing (Repp 1984). Illustrated below is an example of possible category boundary locations (hypothetically) possessed by native speakers of Japanese along a durational continuum:



Cross-linguistic CP research has been conducted to investigate the potential role of linguistic experience in the perception of phonological categories by two groups of monolingual native speakers of two different languages (e.g. Abramson and Lisker 1973). Such research provided the evidence that the ability to discriminate is largely determined by language experience. In other words, lack of experience of a given contrast should result in a poorly-determined perceptual boundary, which separates the two members of that contrast. In this respect, CP research provides important theoretical and empirical basis for the present study. It can be hypothesised that, for the L2 learner of a particular L1 that does not make use of particular speech sounds as a phonological contrast, his perception of those sounds is affected. This hypothesis can be attested by comparing the CPs of phonetic contrasts by L2 learners and the native speakers of that language, in L2 phonological acquisition research.

However, the overall amount of research investigating the CPs of L2 learners at different levels of proficiency/language experience has been very limited, with most recent studies concentrating on the discrimination between /r/ and /l/ by Japanese learners of English, utilising either synthesised or natural speech, or both in their discrimination tests (e.g. Miyawaki, et al. 1975; Mochizuki 1981; MacKain et al. 1981). The results from MacKain et al. (1981) have replicated Miyawaki et al's (1975), indicating that the native speaker group perceived a synthetic /r/-/l/ continuum categorically, whilst the Japanese subjects did not. Furthermore, MacKain et al. (1981)

provided data to show that the experienced Japanese group perceived the continuum 'almost categorically', which was noticeably similar to the native speaker control group, whereas near-chance performance in their discrimination tasks was shown by the 'not-experienced' group.

Thus, based on the findings and research methods from previous CP research, the present research investigates to what extent the L2 learner's CP is different from/consistent with native speakers of Japanese, and how it develops in the adult L2 acquisition process, by utilising varying segmental durations along synthetic continua.

5. Method

5.1 Subjects

A forced-choice word-identification test was conducted with native speakers of Japanese (control group) and three levels of adult native speakers of English, participating in a (residential) six-week intensive Japanese course. The subjects were grouped on the basis of a language experience questionnaire. None of them had hearing disabilities.

The Elementary Group (EG) consisted of 6 learners with classroom instruction of an average 5.5 hours x 5 days x 6 weeks, combined with daily self-study. None of them had had Japanese instruction before attending the course. The Intermediate Group (IG) consisted of 6 learners who had first received Japanese instruction during the previous summer. None of them had any experience of living in Japan. The Near-native Group (NNG) consisted of 2 English-speakers of Japanese at a very advanced level with substantial experience of using Japanese in Japan. The Native Speaker Group (NSG) consisted of 5 native speakers of Japanese. This adds up to 4 groups and 19 subjects in all.

5.2 Materials and stimuli

Four kinds of natural speech word-tokens were digitised on a speech synthesizer (MASSCOMP MC5500 using the Real Time UNIX system and digital-to-analog converter) through a microphone with a sampling frequency of 8 kHz and with an accuracy of 20,000 samples/second. Following this, the word-tokens, /iken/ and /nisi/ were synthetically lengthened by inserting the duration of silence (i.e. the stop gap) preceding the plosion and the duration of fricative noise interval of /s/, respectively. In this way, 10 synthetic word-stimuli were generated along the durational continua in 50-msec increments. One ranging from /iken/ to /ikken/ and the other from /niši/ to /nišši/. On the other hand, the word-tokens, /samma/ and /kaado/ were shortened by reducing the duration of the nasal murmur of /m/ and the vowel duration of /a/ towards the durations of /m/ and /a/ of /sama/ and /kado/, respectively along the continua in 25-msec increments. In this way 10 word-stimuli of each continuum were generated.

Then, each word-stimulus was recorded singly on a cassette tape recorder (NEAL Model 302), with inter-stimulus intervals of 2.0 sec and inter-block intervals of 10 sec, which were inserted after each of 10 separate randomisations of 10 stimuli. 10 stimuli along the /iken/-/ikken/ continuum were repeated and randomised in Task A, and /niši/-/nišši/, /sama/-/samma/, /kado/-/kaado/ followed this principle in Tasks B, C, D, respectively.

Thus, the identification test consisted of 4 tasks for each durational continuum. One task consisted of 10 blocks and each block presented a different order of the same 10 stimuli. In total, 100 (10 X 10) stimuli in one task, and 400 stimuli (10 x 10 x 4) altogether in the test, were presented to the subjects.

5.3 Procedures

The recorded stimuli were presented through headphones, at a comfortable listening level using a language laboratory system (ASC Electric Model AS4M)[3]. Prior to testing, the subjects were instructed orally in their L1 and the non-natives were also given a sheet of all instructions typed in English. A block of stimuli was presented before each task, for the purpose of familiarisation, so that the subjects were informed about the short-long contrast for the particular pair of words to be heard in each task. Such a practice block consisted of all the duplicates of the second blocks of each task. The subjects were asked to indicate their duration judgments by marking 'S' (for a short word) or 'L' (for a long word) on an answer sheet. They were asked to answer immediately after listening to each stimulus during the inter-stimulus interval of 2.0 sec, and to choose the closer word in the case of uncertainty, even when this means guessing. It took approximately 45 minutes to complete all the tasks in the order of A, B, C, and D.

6. Results and discussion

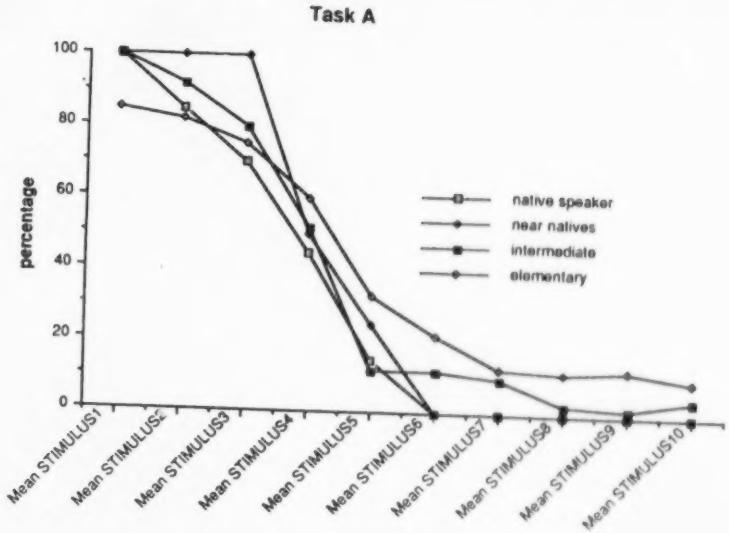
The results are shown in Table 1, indicating the "mean percent responses for short" for each stimulus 1-10, in each task. The four line-graphs also illustrate each table, with the vertical axis of the graph indicating mean percent responses for the identification of a short member of a pair and the horizontal axis stimulus number from 1 to 10.

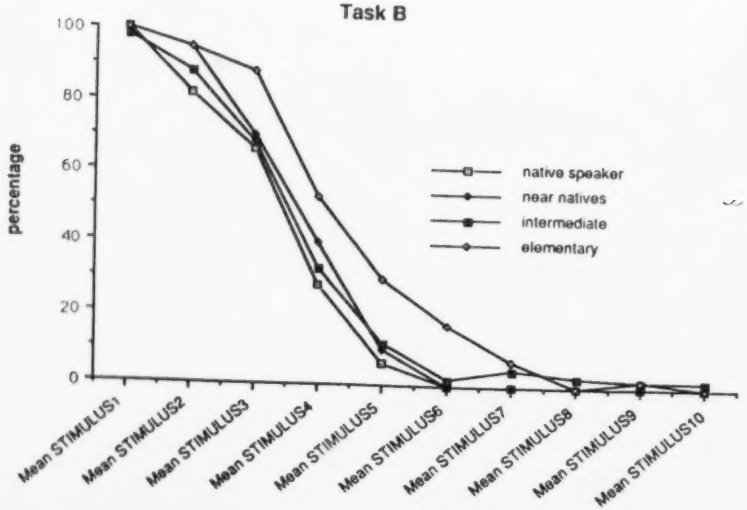
The results, particularly in Tasks C and D, indicate that the NSG perceived the synthetic continua most categorically, showing 'categorical perception' with a sharp category boundary near stimulus 5, dividing the durational continuum into two short-long categories, and both end-point stimuli 1 and 10 were consistently identified 100 % as short and long, respectively. On the other hand, the overall results by the IG and EG did not support the existence of a clear category boundary, still having a small percentage of responses for "short" towards the endpoint of stimulus 10 in all tasks. Furthermore, similar to the findings in MacKain et al.'s study (1981) on a synthetic /r/-/l/ continuum, the overall results of the L2 learners show that the most-experienced group (NNG) perceived the continuum almost 'categorically', which was remarkably similar to the NSG, whereas the identification curves demonstrated by the IG and EG were far less close to the NSG's. Such intra-group data indicates that the learners' levels of language experience/proficiency correlated positively with the closeness of their perceptual categories to that of the native group.

These results may be interpreted as meaning that the NSG has clear perceptual targets/categories for each of the four durational continua, i.e. 'categorical perception' with a clear category boundary dividing the durational continuum into two short-long categories, whereas the L2 learners do not possess/have not yet established such a clear category boundary. This leads us to conclude that the L2 learners' initial perceptual targets/categories can be modified/developed towards the categorical-perception model shown by the native speakers in adult L2 acquisition.

Table 1: Mean percent responses for 'short' for stimuli 1-10

Task A	Native	Near-native	Intermediate	Elementary
1	100	100	100	85
2	85	100	92	82
3	70	100	80	75
4	45	50	52	60
5	15	25	12	33
6	0	0	12	22
7	0	0	10	13
8	0	0	3	12
9	0	0	2	13
10	0	0	5	10
Task B	**Native**	**Near-native**	**Intermediate**	**Elementary**
1	100	100	98	100
2	82	95	88	95
3	66	70	68	88
4	28	40	33	53
5	6	10	12	30
6	0	0	2	17
7	0	0	5	7
8	0	0	3	0
9	0	0	2	2
10	0	0	2	0
Task C	**Native**	**Near-native**	**Intermediate**	**Elementary**
1	100	100	100	98
2	100	100	100	100
3	90	90	87	100
4	25	65	78	77
5	2	30	43	52
6	0	5	32	35
7	0	5	10	3
8	0	0	10	3
9	0	0	0	2
10	0	0	0	0
Task D	**Native**	**Near-native**	**Intermediate**	**Elementary**
1	100	100	98	100
2	100	100	100	100
3	100	100	92	93
4	86	45	77	60
5	0	10	37	28
6	0	10	15	22
7	0	0	0	0
8	0	0	2	0
9	0	0	2	0
10	0	0	2	0





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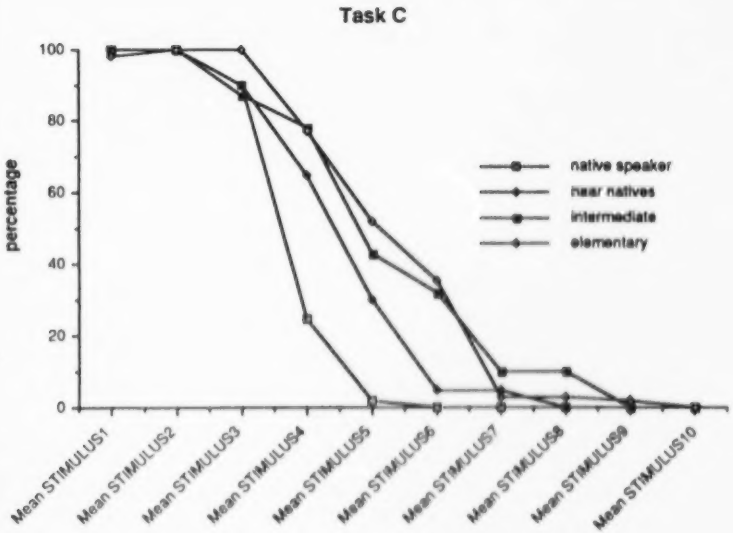
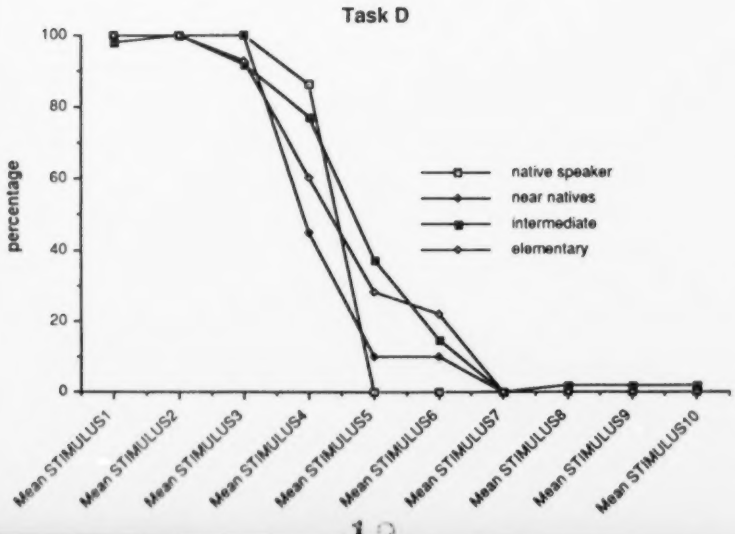

Task C
percentage
100
80
60
40
20
0
native speaker
near natives
intermediate
elementary
Mean STIMULUS1
Mean STIMULUS2
Mean STIMULUS3
Mean STIMULUS4
Mean STIMULUS5
Mean STIMULUS6
Mean STIMULUS7
Mean STIMULUS8
Mean STIMULUS9
Mean STIMULUS10


Task D
percentage
100
80
60
40
20
0
native speaker
near natives
intermediate
elementary
Mean STIMULUS1
Mean STIMULUS2
Mean STIMULUS3
Mean STIMULUS4
Mean STIMULUS5
Mean STIMULUS6
Mean STIMULUS7
Mean STIMULUS8
Mean STIMULUS9
Mean STIMULUS10

However, findings from such a small-scale study involving a single test are far from being generalisable. In terms of the reliability and validity of the test, there are several important methodological issues to be considered before undertaking further research. Individual identification data revealed considerable individual differences within a group. For instance, some subjects in the EG are noticeably more sensitive to the acoustic changes than some subjects in the IG, and so many more subjects need to be tested. With regard to generating synthetic stimuli, further improvement is required. For instance, the selection of pairs of words, the source of word-tokens, the method of shortening and lengthening of a token, the period of increments along a continuum, and the recording of stimuli, will be reexamined and further improved. As regards the presentation of the answer sheets, durationally-contrasted pairs of words will be presented in Japanese script for the NSG and in Roman script for the non-natives, instead of the letters 'S / L' (short/long).

Most importantly, the instructions on how to give responses, explained orally prior to the testing, caused unexpected confusion to two NSG subjects. As a result, the overall mean percent responses in the NSG fell below 100 percent for the shorter-end stimuli of 2-4 in Tasks A and B. This instruction problem may be one of the reasons why their identification curves, particularly in Tasks A and B, become less sharp than they could have been. However, the artificiality of the synthetic stimuli may have influenced the native speakers' perceptions in some way. Another kind of perceptual discrimination test (the AXB discrimination Test) will be conducted in tandem with the identification test, in order to back up such findings.

The overall shapes of the (shown) identification curves also differed amongst the stop, fricative, nasal and vowel continua. Data from previous CP research in the area of phonetics also provides different results between CPs of consonants and vowels. (Non-CP results for vowels are provided by Stevens et al. 1969). In the present study, feedback from the subjects suggested that Task D (for the vowel) proved to be the easiest for all the groups of subjects, whilst Tasks A and B (the stop and the fricative) were felt to be relatively difficult. In relation to this, the order and timing of the tasks will be reexamined and changes implemented.

The total time spent was said to be just about right for their concentration threshold. It was felt that inter-stimulus interval of 2.0 sec and inter-block interval of 10.0 sec were also about right for the subjects to give their responses. The presentation of each practice block proved to be crucial.

The general observation was that the NSG seemed more confident and decisive in giving responses, whereas the L2 learners seemed to be having to guess more often. It may be that the L2 learners perceived the duration of each word, by referring to the previous one they had just heard, whilst the NSG referred to their concept or meanings of the two short and long words, independent of the previous stimulus- duration they had just heard.

7. Conclusion

This article has reported the findings of an analysis of the perceptual discrimination data in the interlanguage phonology of adult English-speakers of Japanese from a perceptual acquisition perspective. The findings of this pilot study suggest that adult non-native speakers of Japanese are, at least, able to develop their perceptual target/category for the

durational continua, closely towards that of the native speakers of Japanese, with a positive correlation with language experience/proficiency in the L2. However, in order to increase both the validity and reliability of the discrimination test (discussed earlier), further perceptual experiments must be conducted to verify or falsify such findings.

Acknowledgement

I would like to thank all the members of staff and the students who participated in BAJS (the British Association of Japanese Studies) Summer Institute of Japanese (1991), for their cooperation in conducting the pilot study.

Notes

1. Voice onset time is referred to as the interval occurring between the beginning of the release of air pressure and the onset of regular vocal cord vibration in the articulation of stop consonants, such as /p/-/b/ and /t/-/d/.

2. There are three main formants characterising vowels, i.e. the first, second, and third formants. The vowel formant values correspond to varying frequencies (Hz) of the air in the vocal tract.

3. The testing was conducted in the language laboratory at the Department of East Asian Studies at the University of Durham, with the subjects participating in the British Association of Japanese Studies (BAJS) Summer Institute of Japanese, 1991.

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